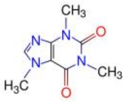


1 H 1.0079 Hydrogen

Unit 1 – Tools of a Chemist

Progress Tracker

Test Date:

Webassign Due *Score*

Packet Progress Checks

Test Readiness Checks:

- ☐ My webassign scores indicate I am ready for the test.
- ☐ I went to ASP for Webassign help when needed.
- ☐ I have completed the unit review AND checked my answers.
- ☐ I am aware that I cannot retake the test unless my webaassign and packet progress checks are all

Learning Objectives

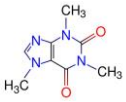
1.1 Basic Measurement and Density
1.2 Dimensional Analysis
1.3 Error in Measurement

1.1 Basic Measurement and Density

- Convert a standard number **to scientific notation** and back. ($6.20 \times 10^{-2} = 0.0620$)
- Demonstrate an understanding of the relative size of numbers presented in scientific notation.
- Make accurate measurements of **length**, **volume**, and **mass** in the laboratory and consistently report appropriate units.
- Measure and calculate the **density** of solids and liquids.

$$D = \frac{M}{V}$$

- Be able to use the **volume displacement** technique.
- Solve for volume or mass algebraically given density data.
- Conceptually relate density to **particulate representations**.
- Given a **graph** of the density of an object, be able to predict the graph of another object given density information.
- Use graphical representations to find the density of an object.
- Understand that density is an **intrinsic property** of a substance and demonstrate an understanding of the independence on amount of the substance.
- Relate density to sinking and floating.
- Design an experiment to measure the density of a substance and report an appropriate procedure and data table.



1.2 Dimensional Analysis

- Understand and apply a **dimensional analysis** approach to converting the units resulting from a measurement. (i.e. – cm to miles)
- Understand why unit conversions are important in science.
- Identify the units that would result from another students dimensional analysis work by careful canceling.
- Use dimensional analysis to convert complex units (i.e – m/s to km/hr)
- Use dimensional analysis to convert squared or cubed units. (i.e.- in^2 to cm^2)
- Apply unit conversions to real world problems that don't have an obvious starting point. (i.e. – will a 16 inch poster fit in a 41 cm tall locker?)
- Distinguish between **English** and **metric** units.
- Demonstrate a conceptual understanding of scale as it relates to metric measurements. (i.e. – is 16 nm or 16 mm a longer measurement?)

1.3 Error in Measurement

- Demonstrate an understanding of why **significant figures** are important in science.
- Distinguish between **measured**, **counted**, and **defined numbers**.
- Consistently report measurements to the correct number of significant figures based on the type of measuring equipment used. (In the lab you should be able to do so without prompting by the teacher.)
- Determine the number of significant figures when using scientific notation.
- Report the correct number of significant figures when:
- Adding and subtracting numbers
- Multiplying and dividing numbers
- Mixed operations
- Distinguish between **accuracy** and **precision** given dart-board style metaphors and simulated student data.
- Calculate the % error in an experiment:

$$\left(\frac{\text{measured value} - \text{true value}}{\text{true value}} \times 100\right)$$

- Evaluate a proposed error to explain if it would result in a measured value being too large or too small.

Conversion Sheet

Metric units: Larger units are on the right, smaller units on the left. Assign the larger unit a value of 1 and add a zero for each unit you move to the right. Look at the exponents. Not all change by 10.

Example: 1 dekameter = 1000 centimeters or 1 megaliter = 1000 kiloliters

Pico	Nano	Micro	Milli	Centi	Deci	Base	Deka	Hecto	Kilo	Mega	Giga	Tera
p 10^{-12}	**n** 10^{-9}	**µ** 10^{-6}	**m** 10^{-3}	**c** 10^{-2}	**d** 10^{-1}	Meter Liter Gram second	**da** 10^{1}	**h** 10^{2}	**k** 10^{3}	**M** 10^{6}	**G** 10^{9}	**T** 10^{12}

Metric to English

1 inch (in) = 2.54 cm
1 pound (lb) = 454 g
1 quart (qt) = 946 mL
1 mile = 1.62 km

Other Conversion Factors

1 mL = 1 cm^3
1 L = 1 dm^3

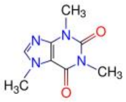
1 pound (lb) = 16 ounces (oz.)
1 yard = 36 inches (in.)
1 mile = 5280 feet (ft.)
1 gallon = 4 quarts (qt.)

1 qt = 2 pints (pt)
8 fl. oz. = 1 cup
16 fl. oz. = 1 pint
32 fl. oz. = 1 qt.
1 ton = 2000 lbs
16 fluid oz. = 1 pint
32 fluid oz. = 1 qt.
1 ton = 2000 lbs

Grading Rubric for the Packet

Packet Progress Rubric – A grade is assigned to each page

0	**2**	**4**
• Less than 50 % of the work is complete. *or* • Work is complete but poor effort is shown.	• 1-2 problems are not completed. • 1-2 written responses are not in complete sentences or a poor effort was made. (CS) • 1-2 mathematical questions don't show work or a poor effort was made. (SW)	• All problems and questions are attempted. • Complete sentences are used for written responses. • Work is shown for mathematical questions. • A best effort was made on each question.



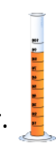
Measurement Notes

Key Skill: Being able measure with the correct number of digits and correct units.

Chemistry involves studying the world by making measurements. You should already be familiar with the measurements that we will need in this course since the most common are length, mass, and volume. Let's start by seeing what you already know. ***As a group, brainstorm examples of metric and English units for length, mass, volume, and time***.

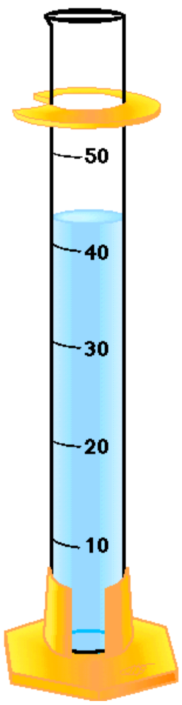
Measurement	**Metric** examples unit symbol	**English** examples unit symbol
Length		
Mass		
Volume		
Time		

To Do:

1. Send one group member to get an Erlenmeyer flask  , a beaker , an a graduated cylinder. 
2. All three of these devices are designed to measure volume. Which of the three do you believe will be the <u>most accurate</u>? EXPLAIN YOUR REASONING:
3. Fill the beaker to exactly 60 mL, then pour it into the graduated cylinder.
4. NOW, WORKING SECRETELY <u>BY YOUR SELF</u>, record the amount on the graduated cylinder as accurately as possible. ______________________ ← What units did you record?

<u>Fold your paper on this line so that your snoopy neighbor doesn't peek at your answer</u>, then pass the cylinder to them and have them read the volume as well. Keep your paper folded until everyone has had their turn. When everyone is done, compare answers and answer the questions on the back of this page.

5. Often when measurements are made, the answers can differ by a small amount. As an example, look at the volume recordings done by 4 students when looking at this graduated cylinder. Which of these student' answers do you think are reasonable? EXPLAIN WHY YOU DISAGREE WITH THE OTHER ANSWERS.

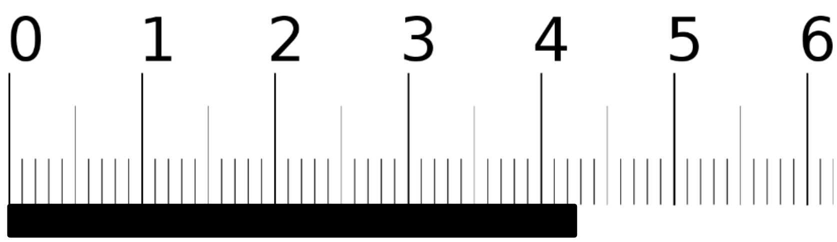


Student	Measurement	Reason that you DON'T like the measurement. (Only fill out ones you disagree with.)
Jill	44 mL	
Josey	40 mL	
Jamie	43 mL	
Jacob	43.6 mL	

E

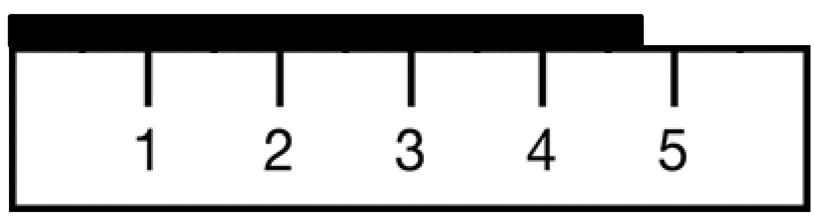
Express the error in this tool: mL $\pm$ mL

6. This principle applies to all measuring tools. Record a good measurement for the length of the line using each of thes rulers



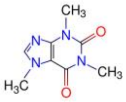
Answer:

Error in this tool: cm $\pm$ cm



Answer:

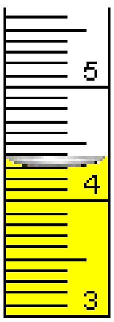
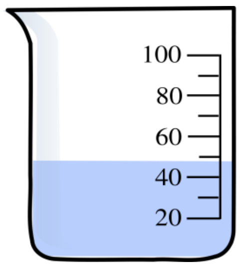
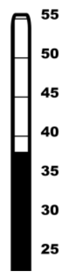
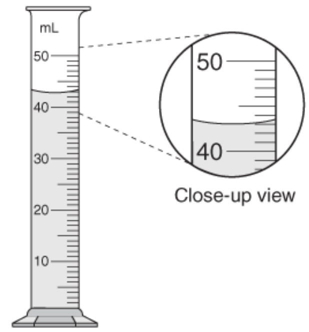
Error in this tool: cm $\pm$ cm

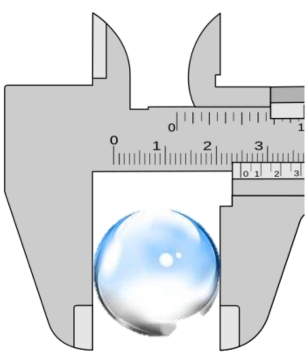
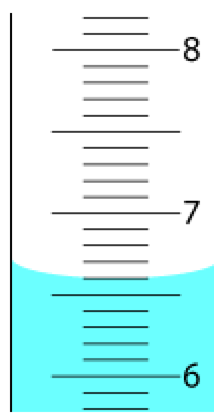
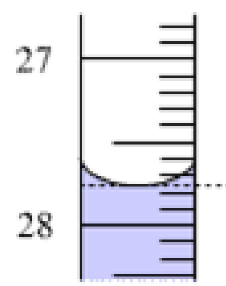


1 H 1.0079 Hydrogen

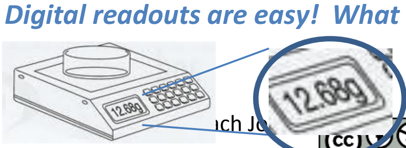
Measurement Practice

Record the measurement using the correct number of digits. Also record the ± value.

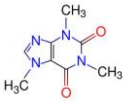
Small Graduated Cylinder	***Beaker***	***Thermometer***	***Large Graduated Cylinder***
			
Measurement: _________ ± ______ *(predict the units as well)*	***Measurement:*** _________ ± ______ *(predict the units as well)*	***Measurement:*** _________ ± ______ °C	***Measurement:*** _________ ± ______ *(predict the units as well)*

Calipers	***Pressure Gauge***	***Small Graduated Cylinder***	***Buret (Careful! – These read in a unique direction!)***
			
Measurement: _________ ± ______ *(predict the units as well)*	***Measurement:*** _________ ± ______ *(predict the units as well)*	***Measurement:*** _________ ± ______ *(predict the units as well)*	***Measurement:*** _________ ± ______ *(predict the units as well)*

Digital readouts are easy! What would be the recording of this device to the correct number digits?



_________ ± ______



Density Lab

Goal: To learn how to measure the density anything.

Part 1: Design a procedure to measure the density of water. Record any measurements that you make and any calculations that you do. Be a problem solver as you do this. Write down questions that you have. Write down hurdles that you overcome as advice to others, when we discuss this. **When done with the water, have a seat** and we will discuss those ideas and issues. (You will have about 10 minutes.)

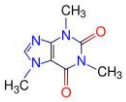
Finding the Density of Water		
Measurements that you made. (With correct number of digits AND units!)	Show your calculations to find the density. (Put units on your answer!)	Questions, thoughts, concerns that came up.

When done with water, leave your equipment out and have a seat for a 5 min. discussion.

% error for the density of water =

Finding the Density of Vegetable Oil		
Measurements that you made. (With correct number of digits AND units!)	Show your calculations to find the density. (Put units on your answer!)	Questions, thoughts, concerns that came up.

% error for the density of vegetable oil =



Questions:

1. Does the density that you found for Vegetable Oil and Water suggest that water should be on bottom or on top when they are mixed? (explain) (Feel free to try this with a small amount of both.)

2. A plastic bottle cap has a density of 0.962 g/mL. Using your measurements:

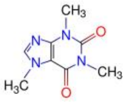
   Would the bottle cap float in water? Why?

   Would the bottle cap float in vegetable oil? Why?

Part 2: How could you figure out the density of a ***cube***? What measurements would you need? Use one of the wooden blocks or cubes of metal and determine its density. Show your measurements and calculations here:

Finding the Density of a Cube	
Measurements that you made. (With correct number of digits AND units!)	Show your calculations to find the density. (Put units on your answer!)

% error for the density of the block =

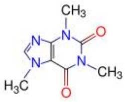


Part 3: Lastly, we want to find the density of something that has an irregular shape. This can be more challenging and is a great opportunity for you to do a little creative problem solving. Of the two variables that we need to know (mass and volume), which will be more difficult to determine with the rock or chunk of metal that you were given?___________________

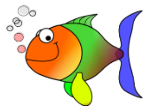
The tools that you have available are the balance and graduated cylinder.

Determine the density of your irregular object (the rock or chunk of metal). Write down what you did (a procedure) in enough detail that someone else could repeat what you did without you being there. Bullet points work fine but be sure to include: 1. The name and amount of all substance used. 2. The glassware and other equipment used. 3. A specific step by step outline of how to do the procedure.

Finding the Density of an Irregular Object	
Measurements that you made. (With correct number of digits AND units!)	Show your calculations to find the density. (Put units on your answer!)
Procedure: (Write legibly and in complete sentences!)	



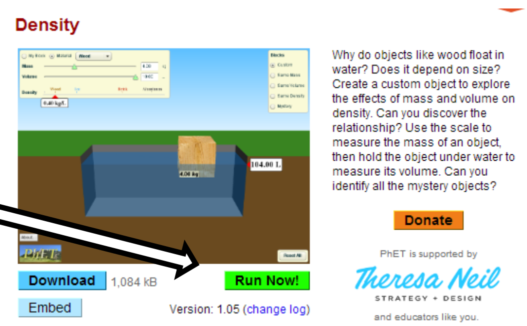
Density ChemGIL



Key Skill: Relating Density Understandings to a Particle View of Atoms.

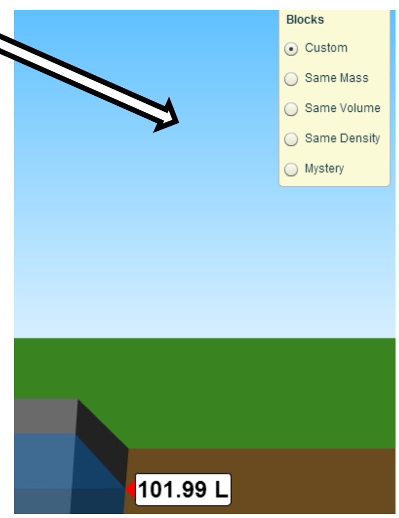
What to do:

- *Work with your partners by exploring, discussing, and writing down new understanding about density that you learn through this exercise.*
- *Go to the website: http://phet.colorado.edu/en/simulation/density and follow the directions below.*



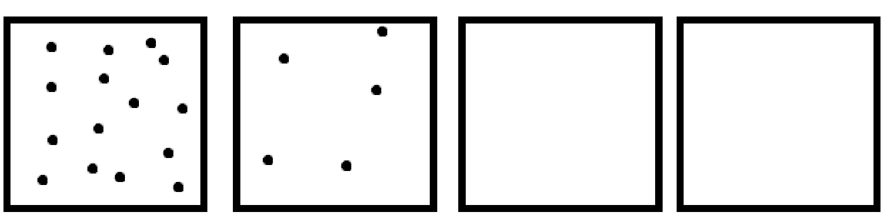
1. *Click on "Run Now".*
2. *Click on "mystery" on the far right of the screen.*
3. *Determine the density of each block:*

Block	*Mass (kg)*	*Volume (L) (You may have to do a little math here.)*	*Density (Include units!)(Consider how many digits to report.)*
A			
B			
C			
D			
E			



4. *Do you believe that any of these blocks are made from the same substance? Why or why not?*

5. *Below are two representations of what the <u>atoms</u> in blocks A and C look like. DRAW a representation of the atoms in blocks D and B.*

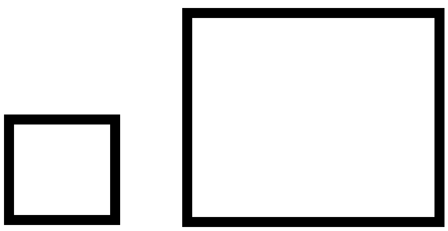


A **C** **D** **B**

6. Based on the fact that block “C” floats in water, what can we conclude about the spacing between molecules of water relative to the spacing between atoms in block C? Explain.

7. Which block (C or E) has more **mass** ? ___________ Which block (C or E) has more **density**? __________

   Explain why the block with more mass is not the block with more density. Use a particle drawing showing atoms in the boxes as part of your explanation.



E C

8. Click on “Show table” on the right of the screen. Which substance is substance “A”? Explain how you know.

Key Skill: Explaining the Impact of Lab Errors

1. Remove all of the blocks from the water except block “C”. We want to answer the following question:

   If a student did not push the block all the way into the water when measuring the volume, would the <u>density that they report end up being to large or to small compared to the true density</u>?

   If you have an initial idea, explain your thinking to your partners.

2. Measure the density correctly and incorrectly (by not pushing the block all the way under the water).

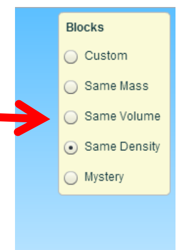
Test	Mass	Volume	Calculated density
Correct Density Measurements			
Incorrect Density Measurements			
AFTER YOU COMPLETE THE TABLE, USE YOUR DATA TO WRITE A CONCLUSION ON THE NEXT PAGE.			

Conclusion: So, was the student's density to high or too low?. Use the density equation in your explanation of why.

$$D = \frac{M}{V}$$

(Be prepared to explain your thinking in class.)

Key Skill: Understanding Density Graphs



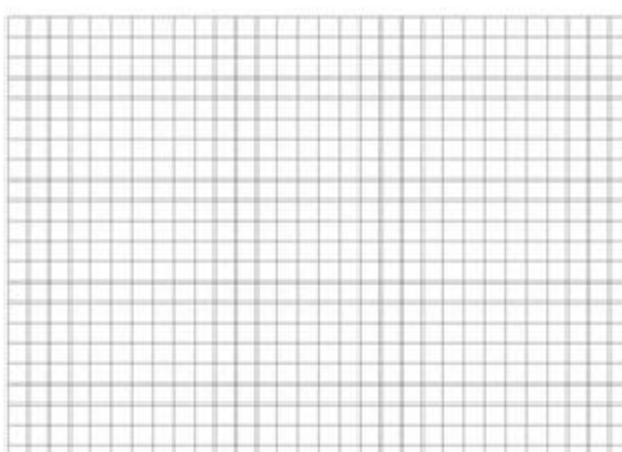
1. Click on the "same density" button on the upper right corner.
2. All of these blocks have the same density. Using one block at a time, record the mass, and volume and record their values on this table. Calculate the density for each.

Block	Mass (kg)	Volume (L)	Density (kg/L)
Green			
Blue			
Yellow			
Red			

3. Now graph the data in this graph.

Volume (L)

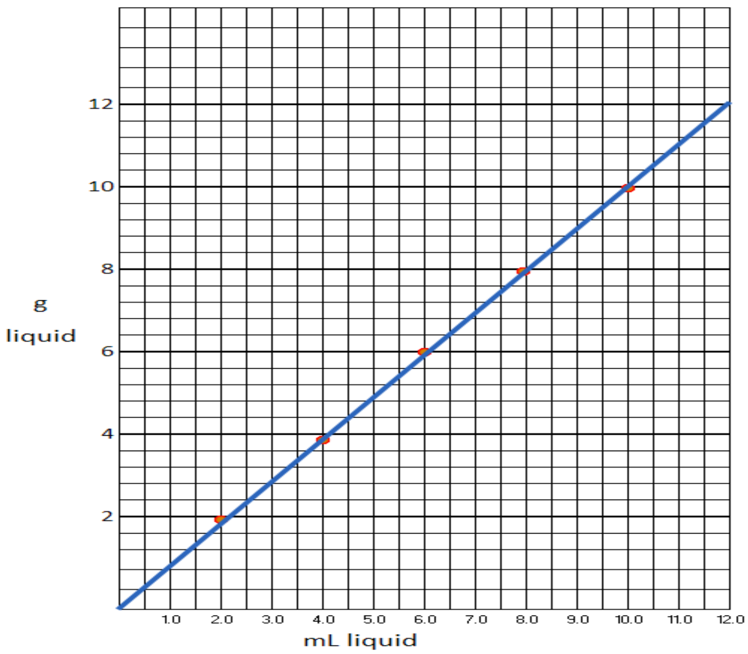
Write your own axis value!



Mass (kg)
Write your own axis values!

4. To determine the density of the substance, you could of course pick any one data point to determine the density of the substance. Describe a method of using the slope of the graph to find the density. Show your work.

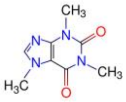
5. What would be the density of this substance?



SHOW YOUR WORK:

6. If you look very closely, you will notice that the data points are not exactly on the line. Why do you think they aren't exactly on the line? (Hint: This was done in a real lab, with real glassware.) Discuss with your group and explain in full sentences here:

7. Do you think that it would be more accurate to determine the density of the solution from an individual data point or from the slope of the graph. <u>Explain your reasoning</u>.



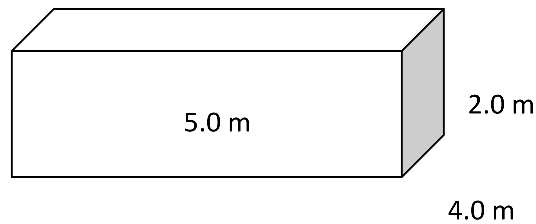
1 H 1.0079 Hydrogen

Density Practice

1. State the formula for density in words and mathematical symbols.

2. A rock has a mass of 210.0 grams and occupies a volume of 70.00 cm^3. What is its density? (Include units!)

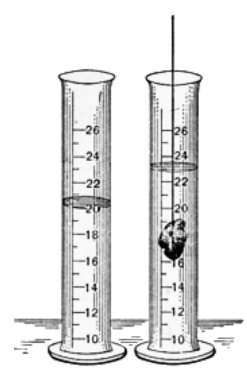
3. A rectangular solid of unknown density is 5.0 meters long, 2.0 meters high and 4.0 meters wide. The mass of this solid is 300 grams. Given this information calculate its density. (Include units!)

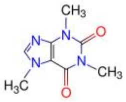


4. A rock has a density of 4.00 g/ml and a mass of 16.1 grams. What is the volume this rock occupies? (Include units!)

5. An unknown substance from planet X has a density of 10. g/ml. It occupies a volume of 80. ml. What is the mass of this unknown substance? (Include units!)

6. A graduated cylinder has 20.0 ml (or cm^3) of water placed in it. An irregularly shaped rock is then dropped in the graduated cylinder and the volume of the rock and water in the cylinder now reads 23.1 ml (or cm^3). The mass of the rock dropped into the graduated cylinder is 6.40 grams. Find the density of the rock dropped into the graduated cylinder.





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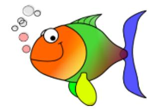
H
1.0079
Hydrogen

Significant Figures ChemGIL



Key Skill: Identifying the significant figures in a measurement.

Information: All measurement equipment has limits on how accurately the measurement can be recorded. We have seen that the number of digits that the measurement can have is dependent on the number of lines marked on the side of the glassware or other device. A really precise piece of glassware can produce lots of digits (which we will call significant figures from now on.)

One piece of metal is weighed on two different balances. Here are the results:

Balance A: 2.3 g — This is a cheap (inexpensive) and low precision balance that produces 2 digits.

Balance B: 2.38 g — This is a better (and more expensive) balance that produces 3 digits.

Some digits in a measurement, however, have are never important (or significant) because they are simply place holders. In the measurement **0**.37 g, the bolded zero was not really measured, it simply emphasized the location of the decimal. Here are 3 important rules for determining if a digit is significant or not:

1. Zeros at the beginning of a number are **never** *significant* (important).
2. Zeros at the end of a number are not significant **unless**… (you'll find out later)
3. Zeros that are between two nonzero numbers are always significant.

Therefore, the number 47,200 has *three* **significant figures**: only three of the digits are important—the four, the seven, and the two. The number 16,150 has four significant figures because the zero at the end is not considered significant. All of the digits in the number 20,007 are significant because the zeros are in between two nonzero numbers (Rule #3).

Critical Thinking Questions

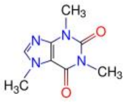
1. Verify that each of the following numbers contains four significant figures. Circle the digits that are significant.

   a) 0.00004182   b) 494,100,000   c) 32,010,000,000   d) 0.00003002

2. How many significant figures are in each of the following numbers?

   _____ a) 0.000015045   _____ b) 4,600,000   _____ c) 2406

   _____ d) 0.000005   _____ e) 0.0300001   _____ f) 12,000



Information: The Exception to Rule #2

There is one exception to the second rule. Consider the following measured values.

It is **1200 miles** from my town to Atlanta.

It is **1200.0 miles** from my town to Atlanta.

The quantity “1200.0 miles” is more precise than “1200 miles”. The decimal point in the quantity “1200.0 miles” means that it was measured very precisely—right down to a tenth of a mile.

Therefore, the complete version of Rule #2 is as follows:

Rule #2: Zero’s at the end of a number are not significant **unless there is a decimal point in the number.** A decimal point ***anywhere*** in the number makes zeros <u>at the end</u> of a number significant.

Not significant because these are at the beginning .

$$\overbrace{0.000000}^{}7290$$

This zero is significant because it is at the end of the number and <u>there is a decimal</u>

Critical Thinking Questions

3. Verify that each of the following numbers contains <u>five</u> significant figures. Circle the digits that are significant.

a) 0.00030200 b) 200.00 c) 2300.0 d) 0.000032000

4. How many significant figures are there in each of the following numbers?

_____ a) 0.000201000 _____ b) 23,001,000 _____ c) 0.0300

_____ d) 24,000,410 _____ e) 2400.100 _____ f) 0.000021

STOP ____ Check with Instructor

Information: Rounding Numbers

In numerical problems, it is often necessary to round numbers to the appropriate number of significant figures. Consider the following examples in which each number is rounded so that each of them contains 4 significant figures. Study each example and make sure you understand why they were rounded as they were:

42,008,000 → 42,010,000

12,562,425,217 → 12,560,000,000

0.00017837901 → 0.0001784

120 → 120.0

Critical Thinking Questions

5. Round the following numbers so that they contain 3 significant figures.

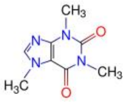
   a) 173,792 b) 0.0025021 c) 0.0003192 d) 30

   __________ ____________ ___________ ___________

6. Round the following numbers so that they contain 4 significant figures.

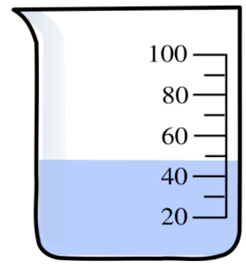
   a) 249,441 b) 0.00250122 c) 12,049,002 d) 0.00200210

   ___________ ____________ _____________ ______________



Key Skill: Reporting the answer of a calculation to the correct number of significant figures. Case #1: Multiplying and Dividing

When measuring the density of a substance, a student records the mass to be 38.41 g from the balance, and they recorded the volume to be 48 mL from your beaker. Which of these two values is a better measurement? Explain:



When you calculate the density by dividing 38.40 by 48 you get 0.800208333333 g/mL…. How many of those digits should we write down? *A good rule of thumb is that the final answer can't have more significant figures than the measurement with the least amount of accuracy*. Think of it this way: If person is playing a guitar and singing, and they are an amazing guitarist, but sing horribly out of tune, the song will end up sounding horrible anyway. This is the same idea with measurements. Here's how to do the math:

1) Count the number of significant figures in each number that you are using in the calculation.
2) Round your answer so that it has the same number of significant figures as the number with the least number of sig figs.

Here's an example:

3 significant figures

$$\frac{4560}{14} = 325.714285714 = 330$$

2 significant figures

Final rounded answer should have only 2 significant figures since 2 is the least number of

Here's another example:

$$13.1 \times 1.2039 = 15.77109 = 15.8$$

3 significant figures

5 significant figures

Final rounded answer should have 3 significant figures since 3 is the least number of significant figures in this problem.

Critical Thinking Questions

7. Solve the following problems. Make sure your answers are in the correct number of significant figures.

a) (12.470)(270) = ________________ b) 36,000/1245 = _______________

c) (310.0)(12) = __________________ d) 129.6/3 = ___________________

e) (125)(1.4452) = ________________ f) 6000/2.53 = _________________

____ Check with Instructor

Key Skill: Reporting the answer of a calculation to the correct number of significant figures. Case #2: Adding and Subtracting

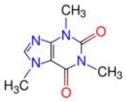
Not all of the math that we do will involve multiplying and dividing (as was the case for density). The rules for adding and subtracting are different and we will do them as a class in just a minute. While you are waiting, review the rules for rounding because we will need them to understand adding and subtracting with sig figs.

Information: Rounding to a desired decimal place

As you will soon discover, sometimes it is necessary to round to a decimal place. Recall the names of the decimal places:

1	7	5,	3	9	8.	4	2	6
The hundred thousands place	The ten thousands place	The thousands place	The hundreds place	The tens place	The ones place	The tenths place	The hundredth s place	The thousandths place

If we rounded the above number to the hundreds place, that means that there can be no significant figures to the right of the hundreds place. Thus, "175,400" is the above number rounded to the hundreds place. If we rounded to the tenths place we would get 175,398.4. If we rounded to the thousands place we would get 175,000.



Critical Thinking Questions

8. Round the following numbers to the tens place.

a) 134,123,018 = ________________ b) 23,190.109 = __________________

c) 439.1931 = __________________ d) 2948.2 = ______________________

____ Check with Instructor

Adding and Subtracting with Significant Figures Examples. (We will do these together as a class.)

Critical Thinking Questions

9. a) 24.28 + 12.5 = __________________ b) 120,000 + 420 = ___________________

c) 140,100 – 1422 = ________________ d) 2.24 – 0.4101 = ____________________

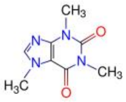
e) 12,470 + 2200.44 = ______________ f) 450 – 12.8 = _______________________

10. The following are problems involving multiplication, dividing, adding, and subtracting. Be careful of the different rules you need to follow!

a) 245.4/120 = ____________________ b) 12,310 + 23.5 = ____________________

c) (31,900)(4) = ___________________ d) (320.0)(145,712) = __________________

e) 1420 – 34 = ____________________ f) 4129 + 200 = _______________________



Scientific Notation ChemGIL

Key Skill: Using and understanding scientific notation.

"**<u>Scientific notation</u>**" is used to make very large or very small numbers easier to handle.

Example #1: The number 45,000,000 can be written as "4.5 x 10^7". The "7" tells you that there are seven decimal places between the **right side** of the four and the end of the number.

Standard Number	Scientific Notation
45,000,000	4.5 x 10^7

Notice: There aren't 7 zero's, but there are 7 decimal places.

Example #2: 2.648 x 10^5 = 264,800 → the "5" tells you that there are 5 decimal places between the **right side** of the 2 and the end of the number.

Standard Number	Scientific Notation
264,800	2.648 x 10^5

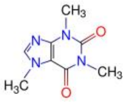
Example #3: Very small numbers are written with negative exponents. For example, 0.00000378 can be written as 3.78 x 10^{-6}. The "-6" tells you that there are 6 decimal places between the **right side** of the 3 and the end of the number.

Standard Number	Scientific Notation
0.00000378	3.78 x 10^{-6}

Example #4: 7.45 x 10^{-8} = 0.0000000745 → the "-8" tells you that there are 8 decimal places between the **right side** of the 7 and the end of the number.

Standard Number	Scientific Notation
0.0000000745	7.45 x 10^{-8}

Draw the "squiggly" counting line" on this one like above.



Critical Thinking Questions

1. Two of the following six numbers are written incorrectly. Circle the two that are incorrect.

a) 3.57×10^{-8} b) 4.23×10^{-2} c) 75.3×10^{2} d) 2.92×10^{9} e) 0.000354×10^{4} f) 9.1×10^{4}

2. What do you think is wrong about the two numbers you circled? Explain.

3. For each of these, write the number in scientific notation:

   a. 0.00451 ______________ (Did you put the decimal to the **right** of the 4?)
   b. 80,340 ______________ (Did you put the decimal to the **right** of the 8?)
   c. 0.00683 ______________
   d. 602,000,000 _____________

4. For each of these, convert the number to standard notation (a normal number):

   a. 9.1×10^{4} _____________
   b. 2.92×10^{-2} _____________
   c. 6.50×10^{-5} _____________
   d. 1.1×10^{6} ______________

5. In each of these pairs, circle the larger number. It may help to convert them from scientific notation to standard numbers to compare. (One of them is a trick question!)

   a. 0.06 or 4.1×10^{-3}

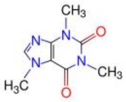
   b. 3.67×10^{2} or 3.67×10^{1}

   c. 8×10^{-3} or 7×10^{-2}

   d. 21.3×10^{-5} or 2.13×10^{-4}

   e. 5.4×10^{4} or 54×10^{4}

STOP ____ Check with Instructor

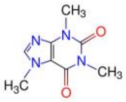


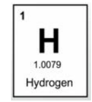
Reflecting on Significant Figures

1. ***What is a significant figure? Why aren't ALL numbers significant?***

2. **Why do we have to adjust the answer to a calculation to the correct number of significant figures? What do we mean by one of the numbers being "weaker" than the other?**

3. ***Contrast how you determine the number of significant figures in an answer when multiplying/dividing with how you find them when adding in subtracting. How is the process different***





Significant Figures Practice

Determine the number of significant digits in each of the following:

1. 23.30 cm
2. 3.65 kg
3. 365 kg
4. 1,843.02 L
5. 8.701°C
6. 2000.12 mm
7. 2.00012 km
8. 0.5 mL
9. 704,000 h
10. 0.0001010450 sec

Report answers to the following using proper significant figures:

11. 3.414 s + 10.02 s + 58.325 s + 0.00098 s

12. 2.326 h – 0.10408 h

13. 10.19 m x 0.013 m

14. 140.01 cm x 26.042 cm x 0.0159 cm

15. 80.23 m / 2.4 s

16. 4.301 kg / 1.9 cm^3

17. An experiment calls for 16.156 g of substance A, 28.2 g of substance B, 0.0058 g of substance C, and 9.44 g of substance D.

How many significant digits are there in each measurement? _____ _____ _____ _____

What is the total mass of substances in this experiment (to the correct number of sig figs)? ______

How many significant digits are there in the answer to part b? _____

18. $\frac{(13.6\ +\ 0.0238)}{42}$ =

19. (0.4 x 80) + (16 x 21) =

20. How many significant figures does this calculation have? (choose an answer)

2.341 – 2.305 =   (a) 1 (b) 2 (c) 3 (d) 4 (e) 5

Solve the following, placing your answers in scientific notation with the proper number of significant digits.

21. $(6.6x10^{-8}) / (3.30x10^{-4})$ =

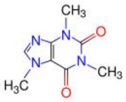
24. $(1.56x10^{-7}) + (2.43x10^{-8})$ =

22. $(7.4x10^{10}) / (3.7x10^{3})$ =

25. $(2.5x10^{-8}) \times (3.0x10^{-7})$ =

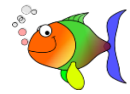
23. $(2.67x10^{-3}) – (9.5x10^{-4})$ =

26. $(2.3x10^{-4}) \times (2.0x10^{-3})$ =



1 H 1.0079 Hydrogen

Unit Conversions CHemGIL



Key Skill: Use a unit cancelling technique to convert one type of unit into another.

To Do:

- Go to the following website: http://joneslhs.weebly.com
- Click on the **Learn** button on the left. Read the tutorial first. When you think that you understand the idea, go back to the Main Menu and click on **One Step Conversions**.

One Step Conversions

- For problems 1, 2, and 3 write down what the completed problem looks like after you have done it on the computer. Cancel the units that cancel. Circle the unit that doesn't cancel. Write down the answer to the problem.

1. =

2. =

3. =

For problems 4-9, you can just write down the answer once you have solved it.

4. Calculated Answer:
5. Calculated Answer:
6. Calculated Answer:
7. Calculated Answer:
8. Calculated Answer:
9. Calculated Answer:

For problem 10, solve it on paper here without using the computer. Then type in the calculated answer to see if you are correct. SHOW YOUR WORK FOR PROBLEM 10 here:

STOP ________________________________ Check with Instructor before moving on.

Multi-Step Conversions

- For problems 1, 2, and 3 write down what the completed problem looks like. Cancel the units that cancel. Circle the unit that is the one left at the end. Write down the answer to the problem.

1.

=

2.

=

3.

=

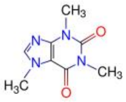
For problems 4-10, you can just write down the answer once you have solved it.

4. Calculated Answer:
5. Calculated Answer:
6. Calculated Answer:
7. Calculated Answer:
8. Calculated Answer:
9. Calculated Answer:

For problem 10, solve it on paper here without using the computer. Then type in the calculated answer to see if you are correct.

SHOW YOUR WORK FOR PROBLEM 10 here:

STOP ______________________________ Check with Instructor before moving on.



Double Unit Conversions

- Read the directions on the first problem to see how to get started. Work through the challenging problems recording your answer for each one.   Don't forget <u>units</u>!

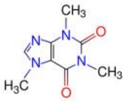
1. Calculated Answer:
2. Calculated Answer:
3. Calculated Answer:
4. Calculated Answer:
5. Calculated Answer:
6. For problem 6, solve it on paper here. Then type in the calculated answer to see if you are correct.

Cubed and Squared Conversions

- Read the directions on the first problem to see how to get started. Work through the challenging problems recording your answer for each one.   Don't forget <u>units</u>!

1. Calculated Answer:
2. Calculated Answer:
3. Calculated Answer:

4. For problem 4, solve it on paper here. Then type in the calculated answer to see if you are correct.



Nonsense Units Practice

Conversion Factors:

1 horse = 3 cows
10 cows = 1 bird
3 birds = 5 lemons
9 lemons = 1 orange
2 oranges = 5 fords
1 ford = 6 trucks

Using the conversion table, solve the problems. No credit given if "**dimensional analysis**" is not used.

1. How many cows in 5 horses?

2. How many lemons in 10 oranges?

3. How many fords in 6 oranges?

4. How many birds in 10 oranges?

5. How many lemons in 18 trucks?

6. How many oranges in 5 horses?

7. How many cows in 15 fords?

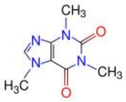
8. How many birds in 2 trucks?

9. How many fords in 1 bird?

10. How many horses in 10 trucks?

Conversion Factors:

1 horse = 3 cows
10 cows = 1 bird
3 birds = 5 lemons
9 lemons = 1 orange
2 oranges = 5 fords
1 ford = 6 trucks



Using Our Conversion Sheet (Notes)

This is the conversion sheet that we will be using for tests throughout the year. It is very compressed and it may help to have a few tips on how it works. Let's start with metric to metric conversions. What would be the conversion factor between each of these?

Conversion Sheet

<u>Metric units</u>: Larger units are on the right, smaller units on the left. Assign the larger unit a value of 1 and add a zero for each unit you move to the right. Look at the exponents. Not all change by 10.

Example: 1 dekameter = 1000 centimeters   or   1 megaliter = 1000 kiloliters

Pico	Nano	Micro	Milli	Centi	Deci	Base	Deka	Hecto	Kilo	Mega	Giga	Tera
p	**n**	**μ**	**m**	**c**	**d**	Meter Liter Gram second	**da**	**h**	**k**	**M**	**G**	**T**
10^{-12}	10^{-9}	10^{-6}	10^{-3}	10^{-2}	10^{-1}		10^{1}	10^{2}	10^{3}	10^{6}	10^{9}	10^{12}

Metric to English
1 inch (in) = 2.54 cm
1 pound (lb) = 454 g
1 quart (qt) = 946 mL
1 mile = 1.62 km

Other Conversion Factors
1 mL = 1 cm^3
1 L = 1 dm^3

1 pound (lb) = 16 ounces (oz.)
1 yard = 36 inches (in.)
1 mile = 5280 feet (ft.)
1 gallon = 4 quarts (qt.)

1 qt = 2 pints (pt)
8 fl. oz. = 1 cup
16 fl. oz. = 1 pint
32 fl. oz. = 1 qt.
1 ton = 2000 lbs
16 fluid oz. = 1 pint
32 fluid oz. = 1 qt.
1 ton = 2000 lbs

Metric to Metric

milliliters to liters?
_____________ = ______________

grams to hectagrams?
_____________ = ______________

decigrams to milligrams?
_____________ = ______________

centimeters to picoliters? (What's wrong with this one?)

_____________ = ______________

English to Metric

What is the key conversion between metric and English for **length**?

What is the key conversion between metric and English for **mass**?

What is the key conversion between metric and English for **volume**?

Practice: How many daL are in 250 pints?

Practice: How many lbs are in 3.4 x 10^9 μg?

Unit Conversions Practice 

To receive credit: SHOW ALL STEPS BY DIMENSIONAL ANALYSIS.

1. How many quarts in 5000 mL?

2. How many mm in 100 cm?

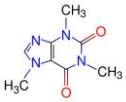
3. How many grams in 300 lbs?

4. Convert 100 km to miles. Now convert that to inches.

5. Change 1000kg to ounces.

6. How many mm in 4 miles?

7. 1 lb of fleas would be contain how many fleas? (One flea weighs 2 mg.)



Derived Units Practice 

SHOW ALL STEPS FOR FULL CREDIT

1. If a substance costs 3.00 cents/ounce, how much would it cost in dollars/ton?

2. If the 100.0 yard dash can be run in 10. seconds, what is this in miles/hour?

3. The density of water is 1.0 g/cm^3 . Change this to lb/ft^3 .

4. If a dog eats 3 grams of food/hour, how much would it eat in tons/century?

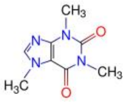
5. If a flea jumps 1.00 mm/microsecond, how fast would that be in miles/hour? (1 microsecond = 1×10^{-6}sec)

6. If a man breathes 1.0×10^2 L/min how many gallons per year would he breathe?

7. If a tree grows 100 angstroms/second how many feet in 1 year?

   (1 Angstrom = 1×10^{-8}cm)

8. If an elf walks 2.00 mm/microsecond how many mi/year?



Accuracy vs Precision Notes

Define **Accuracy** –

Define **Precision** –

Practice #1: Two technicians independently measure the density of a substance:

Technician A	Technician B
2.000 g/cm^3	2.5 g/cm^3
1.999 g/cm^3	2.9 g/cm^3
2.001 g/cm^3	2.7 g/cm^3

The correct value is known to be 2.701 g/cm^3. Which technician is more accurate? Which technician is more precise?

Practice #2: Sarah and Bob have measured the volume of a liquid 3 times each:

Sarah's results	Bob's results
12.3 mL	12.25 mL
12.6 mL	11.60 mL
12.4 mL	11.10 mL

The correct volume is known to be 11.702 mL. Who was more accurate? Who was more precise?